

Reduced Emission Completions (Green Completions)

Lessons Learned
from Natural Gas STAR



Producers Technology Transfer Workshop

Devon Energy and
EPA's Natural Gas STAR Program
Casper, Wyoming
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Green Completions: Agenda

- ★ Methane Losses
- ★ Methane Recovery
- ★ Is Recovery Profitable?
- ★ Industry Experience
- ★ Discussion Questions



Methane Losses During Well Completions

- ★ It is necessary to clean out the well bore and formation surrounding perforations
 - ◆ After new well completion
 - ◆ After well workovers
- ★ Operators produce the well to an open pit or tankage to collect sand, cuttings and reservoir fluids for disposal
- ★ Vent or flare the natural gas produced
 - ◆ Venting may lead to dangerous gas buildup
 - ◆ Flaring is preferred where there is no fire hazard or nuisance



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Methane Losses: Well Completions and Workovers

- ☆ An estimated 45.5 Bcf of natural gas lost annually due to well completions and workovers¹
 - ◆ 45,000 MMcf in losses from high pressure wells
 - ◆ 319 MMcf in losses from low pressure wells
 - ◆ 48 MMcf in losses from workovers
- ☆ An estimated total of 480,000 Bbl condensate lost annually due to venting and flaring
- ☆ This amounts to over \$145 million lost due to well completions and workovers

Note:

- ¹Percentage that is flared and vented unknown
- Value of natural gas at \$3/Mcf
- Value of condensate at \$22/bbl



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Methane Recovery by Green Completions

- ★ Green completions recover natural gas and condensate produced during well completions or workovers
- ★ Use portable equipment to process gas and condensate suitable for sales
- ★ Direct recovered gas through permanent dehydrator and meter to sales line, reducing venting and flaring
- ★ An estimated 25.2 Bcf of natural gas can be recovered annually using Green Completions
 - ◆ 25,000 MMcf from high pressure wells
 - ◆ 181 MMcf from low pressure wells
 - ◆ 27 MMcf from workovers



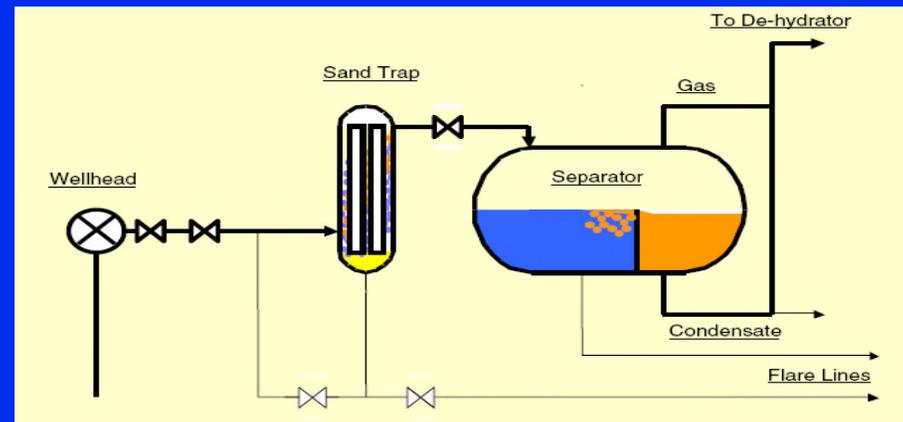
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Green Completions: Equipment

- ☆ Truck or trailer mounted equipment to capture produced gas during cleanup
 - ◆ Sand trap
 - ◆ Three-phase separator
- ☆ Use portable desiccant dehydrator for workovers requiring glycol dehydrator maintenance



Temporary, Mobile Surface Facilities,
Source: BP



Green Completions: Preconditions

- ★ Must have permanent equipment on site before cleanup
 - ◆ Piping from well-head to sales line
 - ◆ Dehydrator
 - ◆ Lease meter
 - ◆ Stock tank
- ★ Sales line gas can be used for fuel and/ or gas lift in low pressure wells



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Green Completions: Low Pressure Wells

- ★ Can use portable compressors to start-up the well when reservoir pressure is low
 - ◆ Artificial gas lift to clear fluids
 - ◆ Boost gas to sales line
- ★ Higher cost to amortize investment in portable equipment



Portable Compressors, Separator and Other Equipment on a trailer

Source: Herald



Is Recovery Profitable?

- ★ Partners report recovering 2% - 89% (average of 53%) of total gas produced during well completions and workovers
- ★ Estimate 7- 12,500 Mcf (average of 3,000 Mcf) of natural gas can be recovered from each cleanup
- ★ Estimate 1- 580 Bbl of condensate can be recovered from each cleanup



Note: Values for high pressure wells

Green Completions: Benefits

- ★ Reduced methane emissions during completions and workovers
- ★ Sales revenue from recovered gas and condensate
- ★ Improved relations with state agencies and public neighbors
- ★ Improved safety
- ★ Reduced disposal costs



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BP Experience

- ★ Capital investment ~ \$1.4 million on portable three-phase separators, sand traps and tanks
- ★ Used Green Completions on 106 wells
- ★ Total natural gas recovered ~ 350 MMcf/year
- ★ Total condensate recovered ~ 6,700 Bbl/year



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BP Experience

- ★ Total value of natural gas and condensate recovered
~ \$840,000 per year
- ★ Investment recovered in 2+ years



Portable Three Phase Separator, Source: BP

Note:

- Value of natural gas at \$1.99/Mcf
- Value of condensate at \$22/bbl



Weatherford Durango Experience

- ★ Successfully completed pilot project in the Fruitland coal formations in Durango, Colorado
 - ◆ Well depth: 2,700 to 3,200 feet
 - ◆ Pore pressure: estimated at 80 pounds per square inch gauge (psig)
 - ◆ Well type: coal bed methane
 - ◆ Hole size: 5 ½ inches
 - ◆ No. of wells: 3 well pilots
- ★ Captured 2 MMcf of gas and sold by client



Weatherford Portable Equipment



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Weatherford Green Completions

- ★ Use pipeline gas with proprietary foaming agent as compressible fluid to initiate cleanout
- ★ System includes
 - ◆ Wet screw compressor when well pressure is less than 80 psig
 - ◆ Booster compressor, three phase separator and sand trap
- ★ Estimate cleanup pressure of 300 to 400 psig at a well depth of 8000 feet
- ★ Suggest use in all kinds of completion and workover cleanup operations



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Discussion Questions

- ★ **To what extent are you implementing this opportunity?**
- ★ **Can you suggest other approaches for reducing well venting?**
- ★ **How could these opportunities be improved upon or altered for use in your operation?**
- ★ **What are the barriers (technological, economic, lack of information, regulatory, focus, manpower, etc.) that are preventing you from implementing this practice?**



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